Carbon Sequestration Benefits of Peatland Restoration - Pocosin Lakes National Wildlife Refuge Cooperative Restoration Project

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Overview

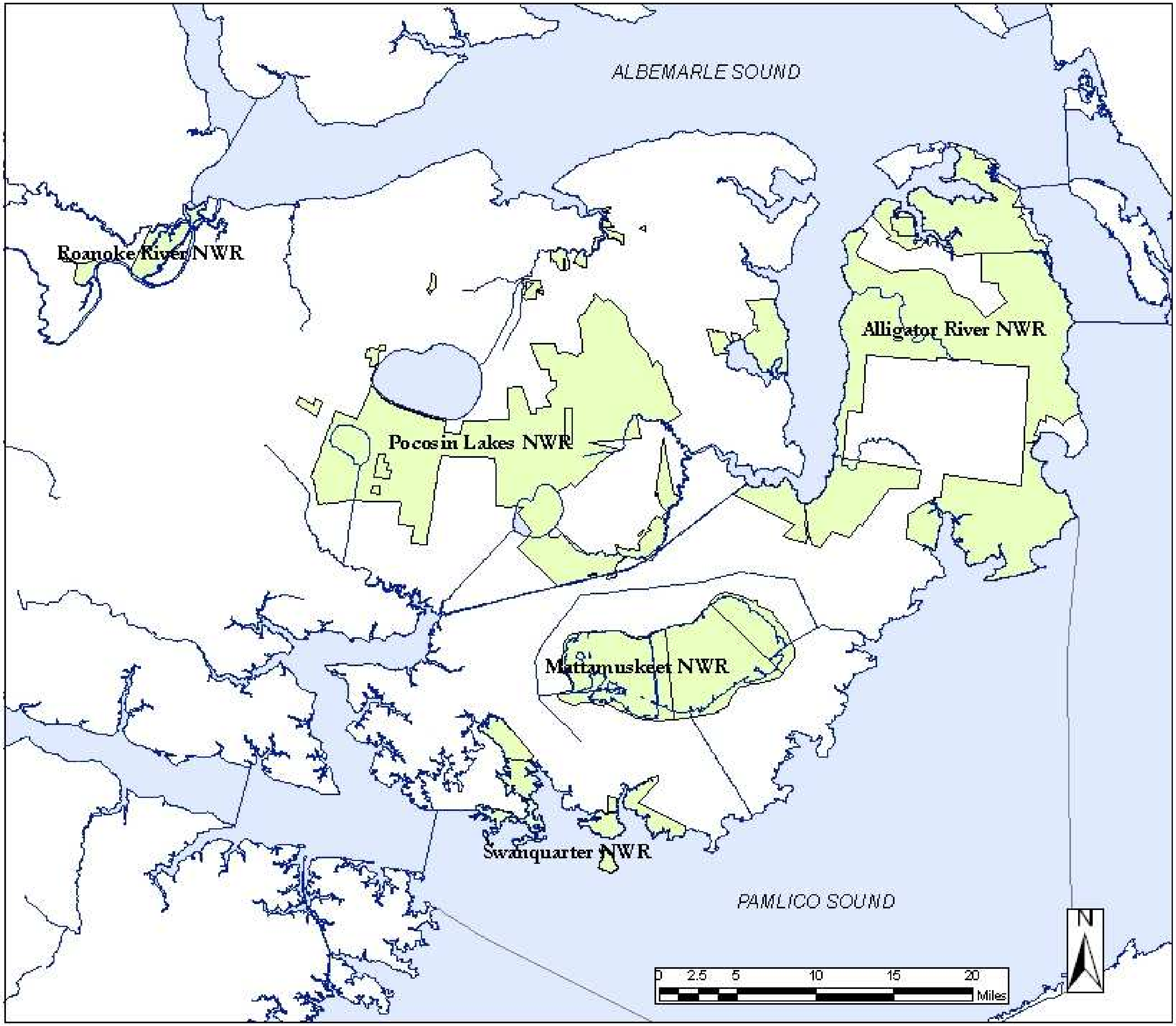
- Wetland Restoration Work At Pocosin Lakes
  - Refuge history
  - Drainage impacts and need for restoration
  - Restoration approach
  - Carbon and nitrogen accounting
  - Costs
- Project Implications for AWC Restoration
- Summary

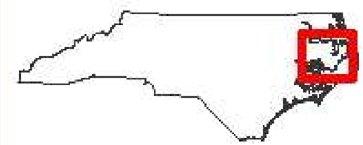
Refuge History

- Land south of Lake Phelps ditched /drained in 60's for ag and peat mining
- Refuge established 1990 with a focus on pocosin restoration
- Hydrology restoration plan 1994
- Restoration and research on-going since
- AWC reintroduction ongoing (seed source for natural regeneration)


Photo: E. Hinesley, NCSU

Pocosin Lakes NWR Area Map





Legend

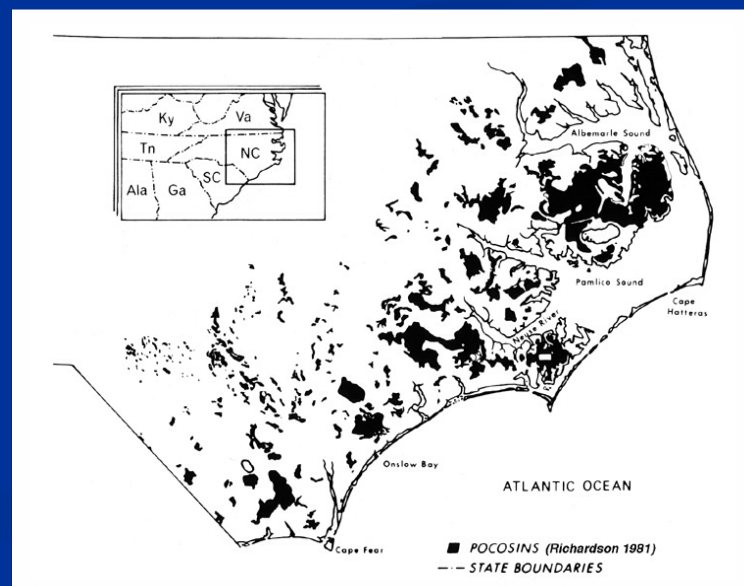
Major Hydrology

Refuge Boundary

What are pocosins?

- southeastern shrub bog wetlands
- dense growth of mostly broadleaf evergreen shrubs
- thick layer of underlying peat soils (Histosols) act as nitrogen and carbon "sponge" over time
- 70% loss of pocosin habitat in NC since 1962
- AWC is keystone refuge species

Healthy pocosin wetlands



1962 pocosin distribution (Richardson 2003)

Importance of pocosin restoration

- Restore wildlife habitat and threatened ecosystems (e.g., AWC)
- Peatland drainage promoted organic matter decomposition and loss of nitrogen and carbon to atmosphere
- Restoration stops soil loss
- Drainage network enhances Hg and nutrient delivery to sensitive downstream waters, this will fix it

Importance of pocosin restoration

- Proper hydrology aids fire management/prevents catastrophic wildfires

2008 Evans Rd Fire: C loss likely exceeded 6 million tons (or amount in 22 million tons of CO_2)

- Adaptation to sea level rise by preventing incremental (oxidation) and catastrophic (burning) soil loss and promoting soil genesis

Restoration Approach

- Install water control structures and culverts
- Use raised roads along the canals as levees
- Re-saturate historically drained areas via rainfall
- Promote sheet flow through water level management

Nitrogen and Carbon Sequestration: Accounting

Drained Condition

N and C loss by oxidation

(SOURCE)

↓

Restored Condition

N and C sequestration

(SINK)

Components of estimate:

1) amount retained that would otherwise be lost without restoration
2) amount retained in peat as soil genesis is re-established
3) amount retained in above ground biomass

1) Amount retained that would be lost without restoration (stop loss)

Rate of peat loss (ft/yr)	X	Bulk density (kg/ft^3)	X	Peat N or C content (%)	X	CF	=	lb/ac/yr sequestered

where CF = conversion factors for ft^2/ac and lb/kg

- Rate of peat loss when drained 0.03 ft/yr
- Bulk density 0.2 g/cm^3
- Peat nitrogen content 1.35%
- Peat carbon content 43%

= 190 lb N/ac/yr and 6100 lb C/ac/yr

2) Amount retained in peat as soil genesis is re-established

Bulk density (kg/ft^3)	X	Peat depth (ft)	X	Peat age (yr)	X	Peat N or C content (%)	X	CF	=	lb/ac/yr sequestered

where CF = conversion factors for ft^2/ac and lb/kg

- Peat depth northwest of Pungo Lake = 7.6 ft
- Peat age northwest of Pungo Lake = 7500 yr
- Soil property info as on previous slide

= 7 lb N/ac/yr and 230 lb C/ac/yr

3) Amount retained in above ground biomass

Above ground biomass (lb/ac)	X	Biomass N or C content (%)	X	Age of mature vegetation (yr)	=	lb/ac/yr sequestered

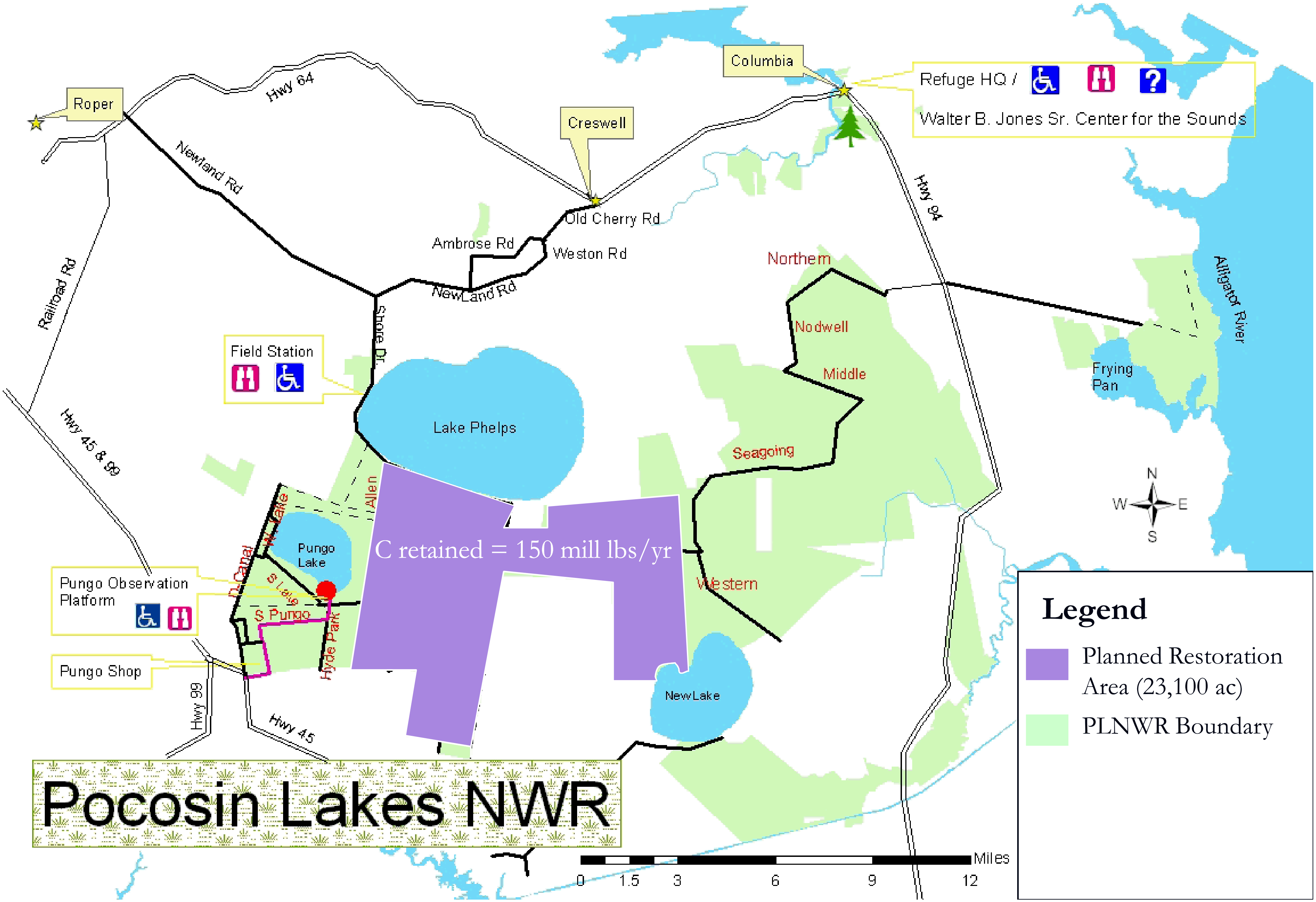
- Above ground biomass in tall pocosin 3300 g/m^2 (29,000 lb/ac)
- Biomass N content 0.09% (mid-range reported for shrub pocosins)
- Biomass C content ~50%

= 0.6 lb N/ac/yr and 140 lb C/ac/yr

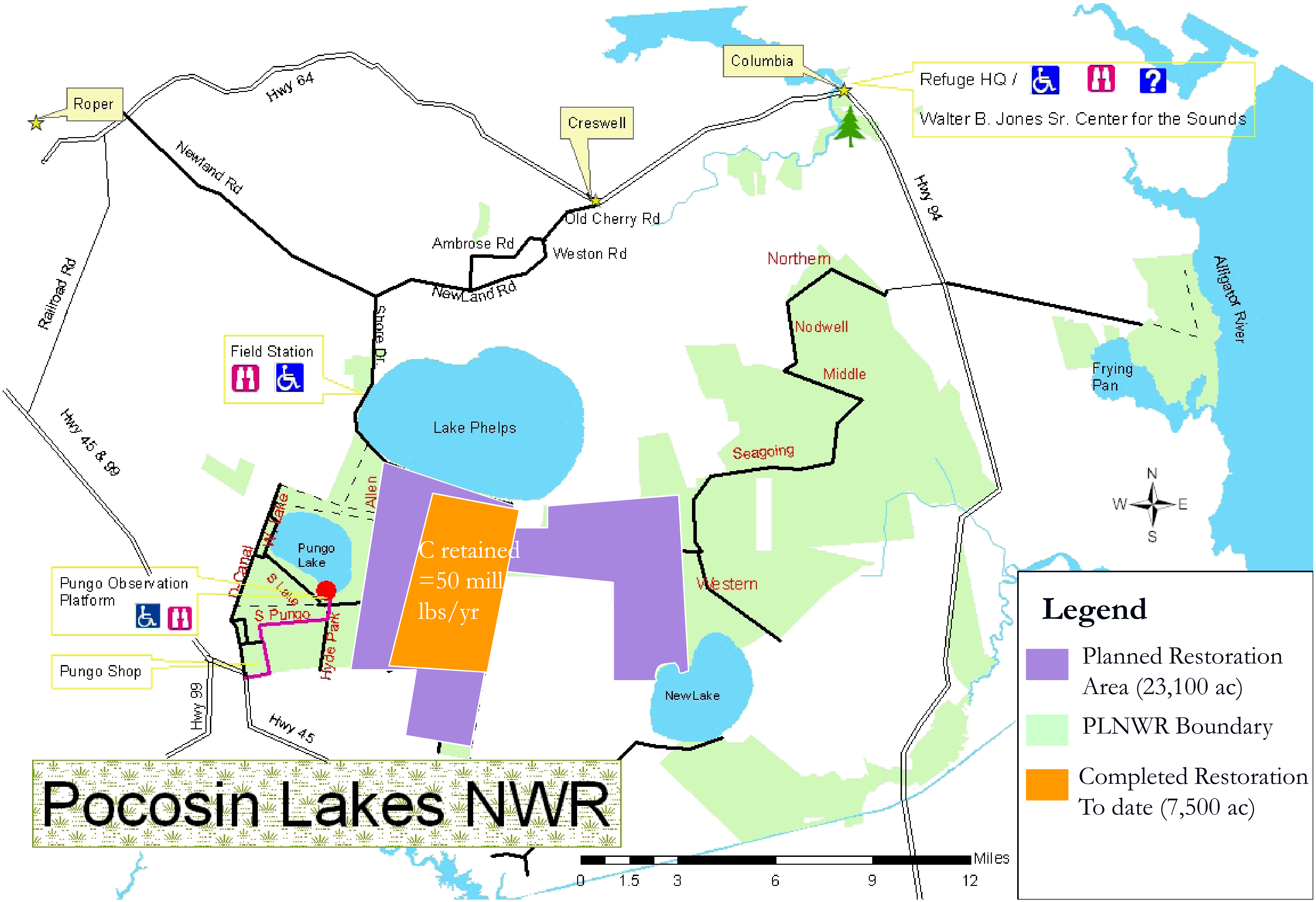
Off-Set Accounting

Components of estimate:	Sequestration (lb/ac/yr) Nitrogen	Carbon
1) amount retained that would otherwise be lost without hydrology restoration	190	6100
2) amount retained in peat as soil genesis is re-established	7	230
3) amount retained in the above ground biomass	0.6	140
TOTAL:	200	6500

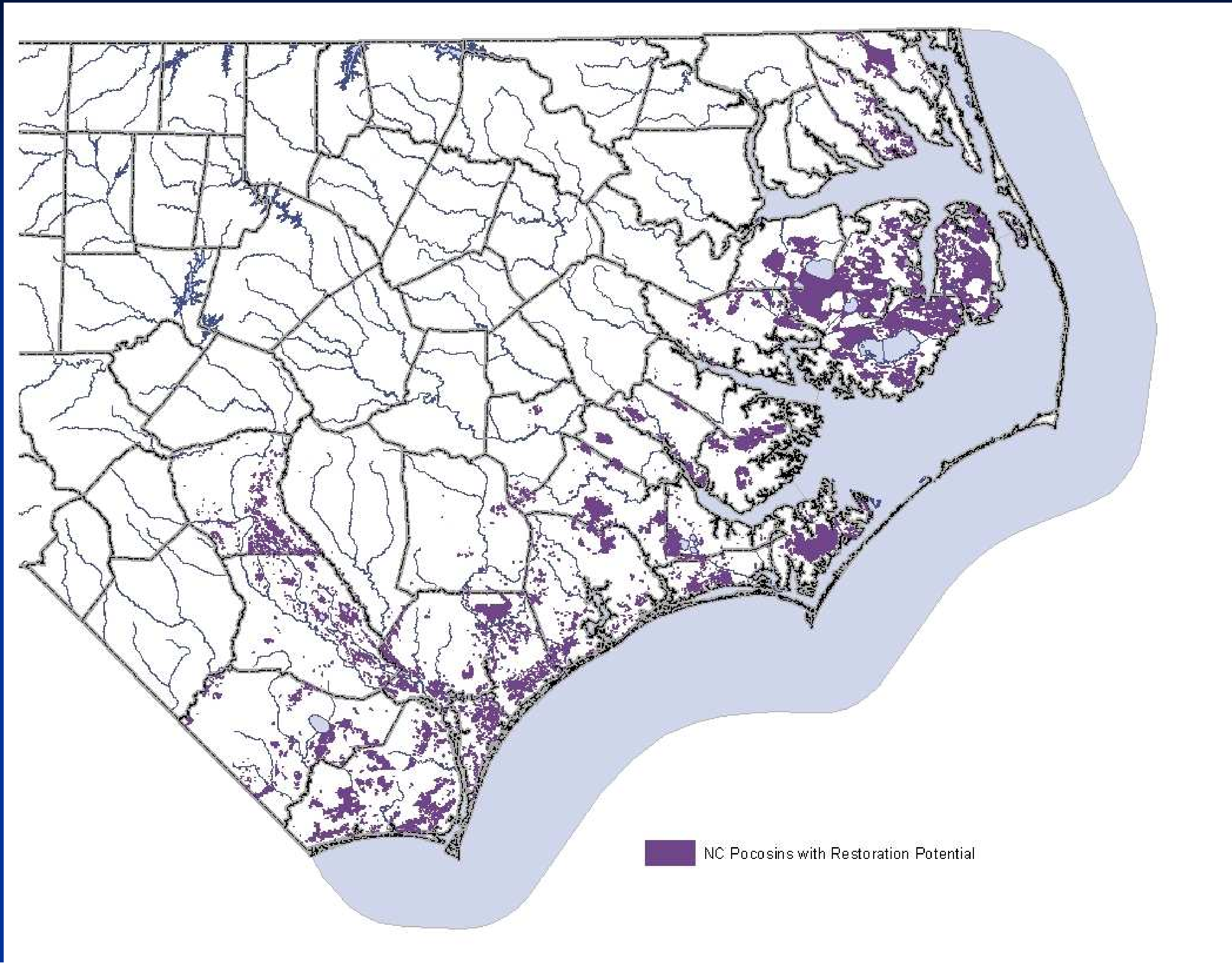
Scope of Restoration



Scope of Restoration



NC Pocosins with Restoration/Enhancement Potential



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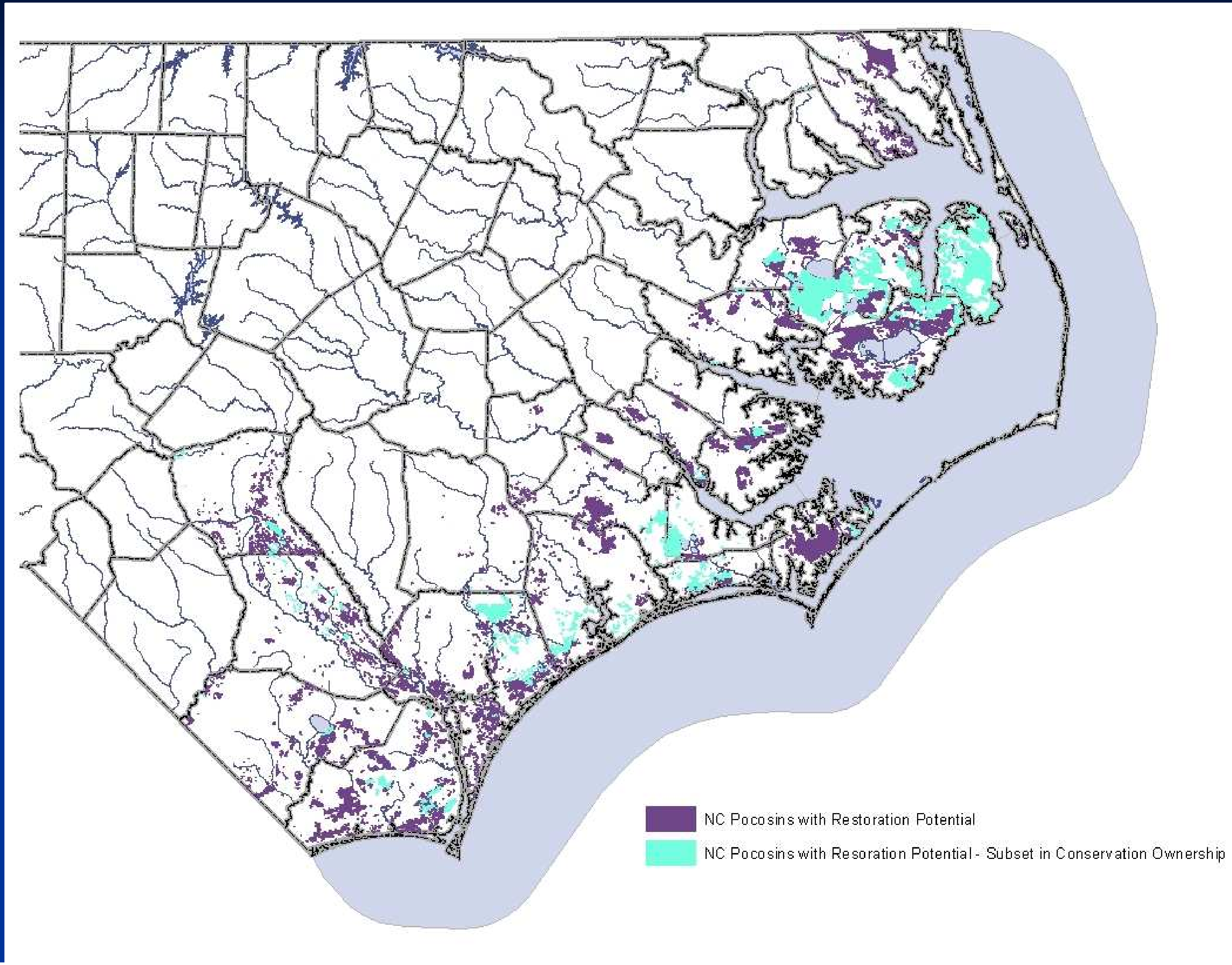


Costs of Restoration

- Costs of restoration in 16,100-acre severely-drained portion of the refuge is ~$ 2.2 million (~ $140/acre)
- Our costs discounted by much work (water control structure installation and levee building) "in house"
- We estimate project cost of ~ $5 million if work was completed through external contracts

A conservative cost range for peatland restoration on conservation lands is between $140 (in-house) and $310 (contract) per acre (or between $11 and $26/ton of CO_2) – one time investment ….annual return

Project Implications: Climate Change

- Carbon sequestration estimate for peatland restoration (6500 lb C/ac/yr) indicates our past project (7500 acres) would sequester the amount of C in ~ 48 million pounds of CO_2/yr

That's equivalent to the average annual CO_2 impact of 11,000 Americans

OR

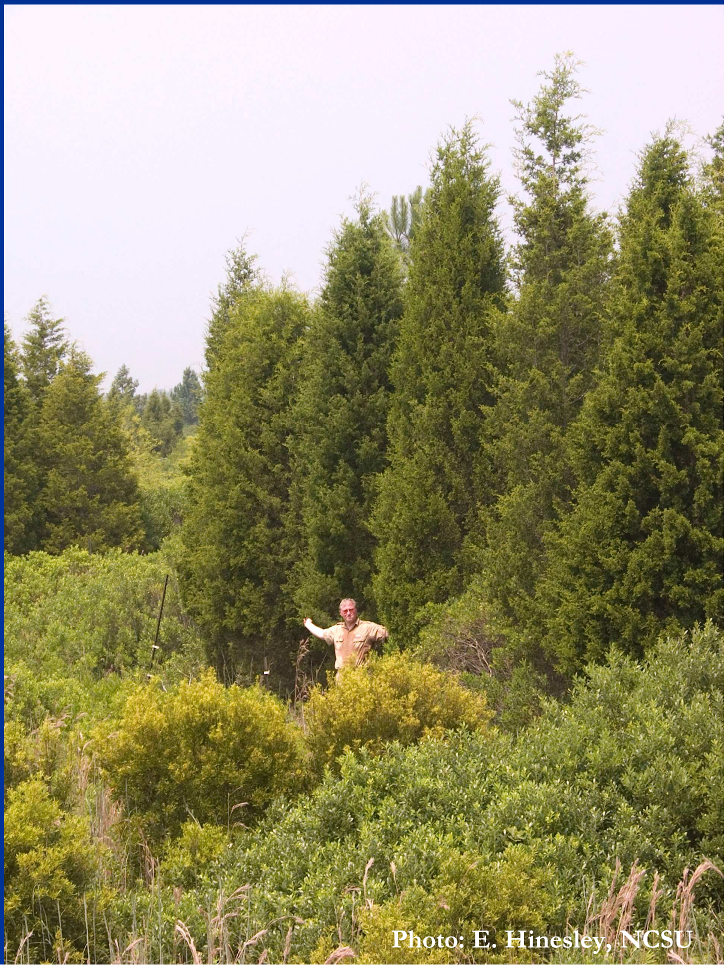
Nearly 1800 times the CO_2 footprint of our office vehicle fleet last year

Source: climatecrisis.net

Project Implications: AWC Restoration

- Wetland restoration projects may be attractive source of carbon credits for others

- Outside investments could be targeted to peat soils with potential to advance restoration of areas that historically supported AWC (opportunity to expand the restoration work with external funds / new partnerships)



Resources

- U.S. Fish and Wildlife Service. 2009. Benefits of wetland hydrology restoration in historically ditched and drained peatlands: Carbon sequestration implications of the Pocosin Lakes National Wildlife Refuge cooperative restoration project, Raleigh Field Office, Raleigh, NC.

  http://www.fws.gov/raleigh/ec_reports.html

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Resources

- C and N budget verification study starts this summer in cooperation with Duke Wetlands Center
  - 3-year assessment of soil levels in response to restoration, carbon inputs and export, including rainfall, soil carbon, soil respiration, surface water, biomass
  - Will determine magnitude of actual carbon and nitrogen sequestration (check-on the site-specific estimates)

Summary

- Pocosin Lakes NWR restoration has important plant community, wildlife, water quality and carbon and nutrient retention benefits
- Potential for similar restoration projects to be important in carbon markets
- New partners / external funds focused on C or N may expand restoration that also benefits rare plant communities, like AWC
- USWFS and partners have estimated the C and N benefits and project costs and will begin a 3-year verification study this summer…those tools may help others design and sell similar projects

Acknowledgements

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Duke University Wetlands Center

The Nature Conservancy


Thanks!